AMENDMENTS TO THE SPECIFICATION

On page 2, lines 6-17, please replace the original paragraph with the following amended paragraph:

--Acquired image data from all types of imaging systems typically contain noise. Noise may result from a wide variety of sources, typically from the various components used to acquire the image data, but may also be a function of the physics of the system, the nature of the subject being imaged, and so forth. Typical image noise may be a mixture of ~~Random~~ random point noise, which may also be referred to as spike noise, and patterned noise. Modalities such as X-ray imaging and optical imaging, where image data is directly acquired exhibit such noise in a readily visible manner. However, imaging methods requiring reconstruction, such as MRI, CT, ultrasound, and so forth, convert point or spike noise into splotches or small streaks and thereafter the point noise is usually hidden with the patterned noise. In either of these cases, it is desirable that the point noise and patterned noise be detected and appropriately mitigated.--

On page 2, lines 25-28, please replace the original paragraph with the following amended paragraph:

--There is a need therefore, for an improved technique for reducing both ~~Random~~ random noise points (spike noise) and patterned noise in the same image. There is a particular need for a technique which is easily implemented, computationally efficient, and which offers options for image enhancement and for time optimization.--

On page 7, lines 1-12, please replace the original paragraph with the following amended paragraph:

--In accordance with the present techniques, the acquired or processed image data forms what may be referred to as an input image. It should be understood that this input image, and other images referred to herein, are actually image data processed by the present techniques. The ultimate reconstructed image is, however, a visual presentation that can be viewed by a user. The present techniques allow for characterization of ~~Random~~ random point noise, which may be referred to in the present context as spike noise, such that this noise may be removed or reduced in the resulting reconstructive image along with patterned noise. Patterned noise reduction will typically be performed by the filtering circuitry described below. Such techniques do not, however, typically account for spike noise. By characterizing and accounting for such spike noise, the overall appearance and clarity of the resulting reconstructed images may be substantially enhanced.--

On page 7, lines 14-31, please replace the original paragraph with the following amended paragraph:

--Fig. 3 represents a diagrammatical representation of a system for performing the functions of the present technique. The system, designated generally by reference numeral 68, may be implemented through hardware, software, firmware or a combination of these media. The system begins with an input image 70 produced by any suitable imaging system. The input image is typically stored on a digital storage device and is accessed by the processing system for enhancement and improvement of the image quality. The system includes a filter 72 which is typically embodied in appropriate software code stored in the system. Certain aspects of the filter may follow generally known techniques as described further below. Image data processed by filter 72 is blended with other processed data as indicated at block 74 in Fig. 3. In order to account for and reduce spike noise in the ultimate image, the spike noise in the input ~~images~~ image is characterized as [[is]] indicated at reference numeral 76 in Fig. 3. The nature and function of the spike noise characterizing module 76 will be described in greater detail below. Once characterized, a separate module

determines a blending regime for the spike noise data as indicated at reference numeral 78. This data is then blended with the filtered data at module 74. The resulting data, then, produces and output image 80 which includes data that can be reconstructed into an enhanced image for viewing, storing, transmitting, and subsequent processing.--

On page 8, lines 16-23, please replace the original paragraph with the following amended paragraph:

--The filter 72 serves to identify and process structural features of the input image and non-structural features or regions. Thus, at block 86 of Fig. 4, routines are performed for identifying structures 88 within the normalized image, and differentiating such structures from non-structures 90. The structures are then processed by anisotropic smoothing as indicated at block 92, followed by sharpening, as indicated at block 94. The non-structure, on the other hand, is processed by isotropic smoothing, as indicated at block 96. The processed structure and non-structure then forms a filtered image, as indicated at reference numeral 98 in Fig. 4.--

On page 9, lines 22-30, please replace the original paragraph with the following amended paragraph:

--The present technique makes use of the observation that random ~~at Random~~ or spike noise points in an image are inconsistent with their neighbors while deterministic data points and structured noise points are consistent. Therefore, a properly chosen consistency metric should separate noise points from the remaining image data. Once identified, appropriately interpolated data points can replace noise points. In this context, appropriate interpolation refers to structure-dependent interpolation. Additionally, the structured noise is processed in accordance with the technique described above. The

present techniques, then, provide a solution to synergistically mitigate both point and patterned noise in digital images.--

On page 10, lines 1-12, please replace the original paragraph with the following amended paragraph:

--As described in greater detail below, to identify ~~Random~~ <u>random</u> noise pixels in digital images, several approaches may be used. All of the approaches involve non-linear filtering. A class of such non-linear filtering is ranked-order filtering. In rank-order filtering, pixel values are arranged in an ascending or descending order, and a value between the extreme values is chosen as the filtered value. If the chosen value is in the middle of the ordered data, filtering may be referred to as median filtering. Median filtering is the most common example of rank-order filtering. Rank-order filtering has the advantage of excluding point processes and spikes in a digital signal without compromising edges even though both have high frequency content. Thus, a difference between the input image and the rank-order filtered image above a threshold will likely represent spike noise in the image data. This remarkable property of rank-order filtering is utilized in certain embodiments of the present techniques.--

On page 10, lines 14-29, please replace the original paragraph with the following amended paragraph:

--A process for characterizing spike noise for blending with filtered or processed image data is illustrated generally in Fig. 5 and designated by the reference numeral 104. The input image 70 is processed through filter 72 and later expanded at step 100 as described above. For characterization of spike noise, the input image is processed through a rank-order filter step 106. The extent of the rank-order filter ~~made~~ may depend upon the definition of a spike for a particular image, imaging modality, and the like. For

example, if spike noise is defined as a single pixel, then a 3 x 3 rank-order filtering kernel may suffice. As will be appreciated by those skilled in the art, for rank-order filtering each pixel of interest is replaced by a value selected from a rank-ordered listing of neighboring pixels. Thus, for a 3 x 3 kernel, 9 pixels, including the pixel of interest are rank-ordered and one of the values is selected to replace the pixel of interest value in the rank-ordered filtered image. Other kernel sizes may, of course, be utilized, such as conventional 7 x 7 kernels. In a present embodiment, the pixel of interest is replaced by a value near but necessarily in the middle of the range of neighboring pixel values. By way of example, the replacement pixel value may be on the order of the 40^{th} to 60^{th} percentile of the range of values.--

On page 14, lines 4-9, please replace the original paragraph with the following amended paragraph:

--Fig. 6 illustrates a variant on the foregoing process, identified as process 118, which may be favored in situations where computational speed is desired. In this example, the input image is rank-order filtered at step 106 as before. However, in this example, the rank-order filtered values are used directly in the blending at step 102. A single blending parameter may be applied, then, with the relationship given above, although the input image values are replaced by the rank-order filtered value.--